Ref: 500-TWF-P-2025
September 26th, 2025

Sustainable Drinking Water Solutions in Rural Punjab, Pakistan

Part 1: Executive Summary

1.1 Introduction to the Tameer e Watan Foundation Clean Water Initiative

The Tameer e Watan Foundation is preparing to launch a flagship welfare project aimed at addressing one of the most pressing humanitarian crises in Pakistan: the lack of access to clean and healthy drinking water. This initiative is a proactive response to the systemic and pervasive water challenges plaguing rural and deprived communities in Punjab. The primary goal of this first phase is to provide sustainable, long-term access to safe drinking water for at least 500 different locations, thereby restoring a fundamental human right and uplifting the quality of life for the most vulnerable populations [1, 2].

1.2 The Urgency of the Crisis and the Solution's Impact

Pakistan is currently grappling with a severe water crisis, having transitioned swiftly from a "water stressed" to a "water scarce" nation [3, 4]. The annual water availability per person has plummeted below 1,000 cubic meters, a critical threshold that signals a profound national challenge [3]. While official data suggests a high percentage of the population has access to an "improved" water source, the reality is that the water from these sources is often unhygienic and toxic. This leads to a devastating human toll, with waterborne diseases being a leading cause of morbidity and mortality. Estimates indicate that more than three million Pakistanis are infected with such diseases annually [3], and contaminated water is linked to 40% of all deaths and 50% of waterborne infections in the country [5]. This project moves beyond a simple short-term fix, offering a holistic, long-term model designed to restore health, dignity, and basic human rights for the affected communities.

1.3 Project Scope, Phased Approach, and Financial Summary

Phase I of this initiative will encompass 500 installations across the most water-stressed districts of Punjab. Each location will be equipped with a deep bore well, a high-capacity Reverse Osmosis (RO) filtration plant, large storage tanks, and a sustainable solar energy solution. A centralized control center will monitor system performance and water quality on a 24-hour basis. To ensure adaptability and cost-effectiveness, the project will deploy a multi-tiered solution model, ranging from Stage 1 for small communities to Stage 4 for larger, more densely populated areas. The total budgetary requirement for this phase has been meticulously calculated to include not only the initial capital expenditure but also a dedicated fund for long-term operations, maintenance, and periodic replacement of key components over a projected 20- to 25-year lifespan.

1.4 Key Recommendations for Long-Term Success

To ensure the project's lasting impact, a series of critical recommendations are presented. First, a mandatory, in-depth hydrogeological survey must be conducted at each site prior to drilling. This will determine the specific contaminants present and allow for the selection of the most appropriate and effective filtration technology. Second, the project's financial model must be built on the principle of long-term sustainability, with a robust and transparent budget for operations and maintenance (O&M) to prevent the system's failure over time. Finally, the project must be founded on a community-led governance model, empowering local water management committees to foster ownership and a collective commitment to safeguarding the resource for future generations.

Part 2: The Problem, the Solution, and Social Impact Analysis

2.1 The Unmet Need: Water Scarcity and Contamination in Rural Punjab

2.1.1 The State of Drinking Water Access: A Statistical Overview

Despite significant achievements in extending water supply infrastructure over the past decades, Pakistan faces a severe crisis of water scarcity and quality. The country's per-capita water availability has plunged below 1,000 cubic meters annually, placing it among the most water-stressed nations globally [3, 4]. While 94% of the population had access to an "improved" water source in 2020, this figure is misleading [3]. The Joint Monitoring Program for Water Supply and Sanitation reveals that only 36% of Pakistanis have access to "safely managed" water, meaning that while people can access a source, the water from it is often unfit for human consumption [3].

This disparity between access and quality has dire consequences. An estimated three million Pakistanis are afflicted with waterborne diseases each year [3], and a staggering 70% of households are reported to drink bacterially contaminated water [6, 7]. These health challenges are compounded by a lack of access to basic sanitation facilities, with 25 million people still practicing open defecation, further polluting water sources and perpetuating the cycle of disease [6]. The economic impact of inadequate sanitation alone has been estimated at 344 billion Rupees, equivalent to nearly 4% of Pakistan's GDP [3].

2.1.2 Geological and Anthropological Survey of Problem Extent

An extensive review of available data and on-the-ground studies reveals a complex and varied landscape of water contamination in rural Punjab. The problem is not uniform but is instead a multifaceted issue with specific contaminants concentrated in different geographical areas.

One of the most concerning pollutants is arsenic. Studies have found high concentrations of arsenic in groundwater across Punjab, with a typical range of 10 to 200 µg/L. In some extreme cases, concentrations as high as 3800 µg/L have been recorded in villages in the Kasur district, causing health issues like arsenicosis in residents [5, 8]. Similarly, in Muzaffargarh, a survey of groundwater samples found that 58% exceeded the World Health Organization (WHO) provisional guideline value of 10 µg/L [9].

Fluoride and other heavy metals also pose significant threats. High fluoride levels have been reported in areas like Kasur, Raiwind, and Manga, leading to serious health implications, particularly for children [8, 10]. Reports also indicate elevated concentrations of heavy metals in cities such as Lahore, Vehari, and Multan [11], while Bahawalpur has been identified with high levels of arsenic, iron, fluoride, and Total Dissolved Solids (TDS) [8]. In the Rahim Yar Khan district, a vast majority of the deeper groundwater is highly mineralized and saline, with TDS values exceeding 11,000 mg/L in over 85% of the area [12]. This high salinity renders the water unusable without extensive treatment.

Bacteriological contamination, primarily from fecal matter, is widespread due to a lack of proper sanitation and leaking sewage systems [8, 10]. A study in Bahawalpur found that 75% of groundwater samples were contaminated with coliform bacteria [13].

A key consideration for this project is the assumption that drilling a deep bore well (800 to 1,000 feet) will guarantee a safe water source. However, this assumption is not universally valid. The geological and hydro-geochemical reality on the ground presents a more complex picture. For instance, research from Muzaffargarh reveals that even deeper wells, tapping into older groundwater, were found to contain high arsenic levels (>50µg/L) [9]. Similarly, in Rahim Yar Khan, 90% of the deep groundwater below 75 feet is highly saline and unsuitable for use without advanced treatment [12]. This demonstrates that a one-size-fits-all approach is not sufficient and that the project must incorporate mandatory, in-depth water quality testing at each of the 500 locations to tailor the solution to the specific contaminants and geological conditions of the area.

2.2 The Multifaceted Human Impact: Health, Social, and Economic Deprivation

2.2.1 High Mortality and Morbidity: The Link Between Contamination and Waterborne Diseases

The health crisis stemming from water contamination in Punjab is profound. Contaminated water is responsible for 40% of all deaths in Pakistan, and 50% of the country's diseases are a direct result of consuming polluted water [5]. The problem disproportionately affects the most vulnerable. Diarrhea, a direct result of consuming contaminated water, is the second leading cause of death in children under five in Punjab [10]. Providing access to an improved source of drinking water can significantly improve a child's health, making them 1.8 times less likely to be underweight [6, 14]. The health consequences extend beyond short-term illnesses; long-term exposure to contaminants like arsenic and fluoride leads to chronic conditions such as arsenicosis and skeletal/dental fluorosis, as well as a heightened risk of typhoid, cholera, and hepatitis [8, 15].

2.2.2 Deprivation of Basic Human Rights: A Framework for Analysis

The provision of safe drinking water is recognized by the Government of Pakistan as a fundamental human right [2]. The current crisis represents a failure to uphold this right for millions of rural residents. The economic impact is devastating, not just on a national scale (estimated at 4% of GDP) [3], but also at the individual and community level. Water scarcity forces agrarian communities to rely on expensive and poor-quality tube well water, which negatively affects crop yields and the income of farmers [16]. This struggle for a basic resource also incites social conflicts and drives migration from rural to urban areas, exacerbating an already strained national infrastructure [4].

2.2.3 The Burden on Women, Girls, and Community Life

The human cost of the water crisis is disproportionately borne by women and girls. They are typically responsible for fetching water, a task that can consume 4 to 6 hours of their day [4, 17]. This physically demanding chore has severe consequences on their well-being. The act of carrying heavy water containers over long distances leads to chronic spinal conditions, pelvic deformities, chronic fatigue, and joint pain [4, 18]. This burden also has a direct impact on their ability to pursue education, with the time spent on water collection contributing to a high school dropout rate among young girls [17]. By providing a local, accessible, and safe water source, this project aims to directly alleviate this burden, freeing up time for women and girls to attend school, engage in productive activities, and improve their overall health and quality of life. This social and educational empowerment will be a key, measurable outcome of the project's success.

2.3 Review of Existing Interventions and Lessons Learned

2.3.1 Government and NGO Initiatives: Successes and Gaps

The provision of clean water in Pakistan has been the focus of numerous government and non-governmental organization (NGO) initiatives. The Government of Pakistan's "Clean Drinking Water for All" project, launched in 2004, successfully installed 302 water purification plants in four districts of Punjab [19]. Similarly, the World Bank has approved a $442 million project to improve water and sanitation for more than six million people in rural Punjab [20]. Several NGOs, such as The NGO World and WaterAid, have also undertaken similar projects, emphasizing community participation and sustainability [1, 21].

2.3.2 The Sustainability Challenge: Beyond the Technical Fix

While past efforts have demonstrated the feasibility of installing water filtration plants, a deeper analysis reveals a significant challenge: long-term sustainability. The research shows that many projects fail not because of a lack of initial funding or technical expertise but due to poor long-term planning, management, and a failure to secure ongoing operational and maintenance budgets. For example, a review of the "Clean Drinking Water for All" project found that the available reports did not contain information on the long-term performance and maintenance strategies [19].

This lack of a forward-looking plan for upkeep is a common pitfall. A powerful case study from Muzaffargarh, provided by Oxfam, demonstrated that the success of a flood preparedness project was not due to a "special technical fix" but to "tried and tested participatory methods" that empowered the community and built trust with authorities [22]. This indicates that simply providing the technology is not enough; the solution must be embedded within a framework of strong community engagement and sustainable management. This project will therefore be designed to move beyond a singular "technical fix" and instead build a lasting model of community ownership and financial viability.

2.4 Our Proposed Intervention: A Sustainable and Multi-Tiered Solution

The Tameer e Watan Foundation's project is designed as a direct response to the identified gaps in existing interventions. The proposed model incorporates a deep bore well (800 to 1,000 feet) [23], a high-capacity RO filtration plant [24], and a solar energy solution [25, 26] to address the specific problems of water quality, availability, and reliability in rural areas. The system will be managed by a centralized control center, providing 24-hour monitoring and control [27, 28]. Most critically, the project will not deploy a single, uniform solution. Instead, it will be executed through a tiered approach, allowing the foundation to tailor the solution to the specific population size and contaminant profile of each of the 500 locations. This adaptability is the key to providing an effective and responsible solution in Punjab's hydro-geochemically diverse landscape.

2.5 Framework for Measuring Socially Measurable Outcomes

To quantify the project's impact and ensure its effectiveness, a robust framework for measuring social outcomes will be implemented. This framework will track both health-related and socio-economic indicators.

- **Health Indicators:** The project will monitor for a projected decrease in the incidence of waterborne diseases, reduced child mortality rates, and an improvement in children's nutritional status.
- **Socio-Economic and Educational Indicators:** Measurable outcomes will

include the tracking of time saved by women and girls, with a correlation to an increase in their school attendance and participation in household or community-based productive activities. This data will be collected through regular on-site surveys and integrated into the centralized monitoring system for a comprehensive overview of the project's success.

Part 3: Budgetary Requirements, Locations, and Project Timeline

3.1 Identification and Vetting of Target Locations (Phase I)

3.1.1 Location Selection Criteria: Data-Driven and Needs-Based Approach

The selection of the 500 locations for Phase I will be a critical step to ensure maximum impact. The process will be guided by a two-pronged, data-driven methodology. The initial phase will involve a desktop survey to identify the most water-stressed and socio-economically deprived districts in Punjab. This will include districts with high documented levels of arsenic, fluoride, and bacterial contamination, such as Kasur, Bahawalpur, Muzaffargarh, and Rahim Yar Khan [8, 9, 12, 13]. The second phase will involve on-the-ground, needs-based assessments, prioritizing rural areas with a high percentage of households lacking clean water access and a high incidence of child mortality and poverty [29, 30]. This methodology ensures that the solutions are deployed where they are most critically needed.

3.1.2 List of 500 Identified Locations and Geographic Coordinates

The specific list of the 500 locations and their geographic coordinates will be compiled following the initial site surveys and needs assessments as outlined above. This list will be maintained in a separate, secure database for project management and monitoring purposes.

3.2 Proposed Solution Tiers and Technical Specifications

To meet the varied needs of different communities, the project will utilize a multi-tiered solution model. Each tier is designed to be scalable and adaptable to the specific requirements of a given site.

Table 1: Tiered Solution Specifications (Stage 1 to 4)

Tier/Stage	Target Population	Average Capacity	Key Components
Stage 1 (Small)	Small village/a few households (up to 1,000 people)	Up to 1,000 LPD (264 GPD)	RO/UF system [31], 800 ft bore [23], 2000-gallon storage [32], 5kW solar [26]
Stage 2 (Medium)	Large village or cluster (1,000-5,000 people)	1,000-5,000 LPD (1,320 GPD)	RO/UF system [31], 900 ft bore [23], 5000-gallon storage, 10kW solar [26]
Stage 3 (Large)	Large community/small town (5,000-15,000 people)	1,000-2,000 LPH (5,280 GPD)	Commercial RO plant [33, 34], 1000 ft bore [23], 10,000-gallon storage, 20kW solar [26]
Stage 4 (Extra-Large)	Larger communities (>15,000 people)	Multiple Stage 3/4 installations	Scalable system, multiple units, tailored design [33]

3.3 Comprehensive Budgetary Analysis and Total Fund Requirement

The budgetary analysis for Phase I must address a fundamental misunderstanding: the long-term sustainability of the project. A sustainable solution for a 20- to 25-year lifespan cannot be achieved "without putting any further budget and efforts for the upgradation, repair or restructuring." Key components, such as RO membranes, have a lifespan of only 3 to 5 years, while the plants themselves may last 10 to 15 years [35, 36]. Solar batteries and other equipment also have defined lifecycles. Therefore, the budget has been structured to transparently account for both initial capital expenditure and essential long-term operational costs.

3.3.1 Detailed Cost Breakdown per Installation (Capital Expenditure)

The total capital expenditure (CapEx) for each installation will be a composite of several key components, as detailed in the following table. These are initial costs and do not account for future maintenance or component replacement.

Table 2: Estimated Capital Cost Breakdown per Installation (PKR)

Component	Stage 1	Stage 2	Stage 3
Deep Bore Drilling (800-1000 ft)	Rs 800,000	Rs 900,000	Rs 1,000,000
Submersible Pump & Installation (5-10 HP)	Rs 50,000	Rs 60,000	Rs 70,000
High-Capacity RO Plant	Rs 100,000	Rs 500,000	Rs 1,500,000
Solar Energy Solution (5-20 kW)	Rs 458,000	Rs 658,000	Rs 2,000,000
Civil Works (structure)	Rs 150,000	Rs 200,000	Rs 300,000
Storage Tanks & Plumbing	Rs 50,000	Rs 100,000	Rs 200,000
Centralized Monitoring System (SCADA)	Rs 20,000	Rs 30,000	Rs 50,000
Total Estimated Capital Cost	**Rs 1,628,000**	**Rs 2,448,000**	**Rs 5,120,000**

Note: Cost estimates are approximate and based on aggregated data for commercial and industrial products.

3.3.2 Long-Term Operations and Maintenance Cost Projections

The long-term viability of the project hinges on a dedicated O&M fund. A responsible budget must project and allocate funds for:

- **Labor:** A local operator will be required for daily on-site management. The average salary for a water treatment operator is approximately Rs 1.17 million per year [37]. This cost must be factored in for each site.
- **Parts & Consumables:** Filters and membranes will need regular replacement. A typical RO membrane for a community plant can cost anywhere from Rs 2,000 to Rs 10,000 or more [38], and they must be replaced every 3-5 years [36]. Pre- and post-filters also require periodic replacement. An annual maintenance budget of Rs 10,000 to Rs 50,000 per plant is a reasonable projection for these costs [39].
- **Major Overhauls:** The RO plants themselves have a lifespan of 10 to 15 years [35]. A significant budget must be allocated to replace the entire system at the end of its life to ensure the promised 20- to 25-year sustainability.

3.3.3 Total Budgetary Requirement for Phase I (500 Locations)

The total fund requirement for Phase I is calculated by summing the initial capital costs for all 500 locations and adding a separate, dedicated fund for long-term O&M, as well as a necessary contingency. The distribution across the tiers will be determined by the site surveys, with a projected average distribution used for this initial estimate.

Table 3: Total Budgetary Requirement for Phase I (500 Locations)

Category	Estimated Cost (PKR)
Capital Expenditure (CapEx)	
Stage 1 (250 sites @ Rs 1,628,000)	Rs 407,000,000
Stage 2 (150 sites @ Rs 2,448,000)	Rs 367,200,000
Stage 3 (100 sites @ Rs 5,120,000)	Rs 512,000,000
Subtotal CapEx	**Rs 1,286,200,000**
Operational Expenditure (OpEx)	
O&M Fund (20-25 years, labor, parts, overhauls)	Rs 1,500,000,000
Contingency Fund (approx. 15%)	**Rs 417,930,000**
Total Estimated Fund Requirement	**Rs 3,204,130,000**

This total fund requirement represents a responsible and realistic assessment of the investment needed to achieve the project's long-term objectives and avoid the failures of past initiatives.

3.4 Estimated Project Timeline (Phase I)

The project timeline for Phase I is estimated to be approximately 36 months, broken down into the following key phases:

- **Months 1-6:** In-depth site surveys, hydrogeological assessments, and location finalization.
- **Months 7-12:** Procurement of materials, equipment, and civil works contracts.
- **Months 13-30:** Deep bore drilling, civil structure construction, and installation of all equipment (staggered by location).
- **Months 31-36:** Commissioning of plants, centralized monitoring setup, and training of local operators and community committees.

Part 4: Conclusion, Sustainability, and Expansion Plans

4.1 Ensuring Long-Term Sustainability: A Self-Sustaining Model

The Tameer e Watan Foundation recognizes that the long-term success of this project is not guaranteed by the initial capital investment alone. It is instead dependent on the establishment of a robust, self-sustaining model for operations and maintenance. This model directly addresses the shortcomings of previous projects that failed to plan for the cyclical replacement of parts and the ongoing costs of labor and energy [19, 40].

4.1.1 Operations & Maintenance (O&M) Protocol and Costing

The project's longevity is a direct function of its O&M protocol. A key element of the project's financial plan is the upfront allocation of a dedicated O&M fund. This fund will cover the cost of periodic maintenance, including the replacement of RO membranes every 3-5 years [35, 36] and the eventual overhaul of the entire plant every 10-15 years [35]. The foundation will also develop a small, user-fee model with the communities to help offset a portion of the long-term costs, fostering a sense of shared responsibility and ownership.

4.1.2 Community Ownership and Empowerment Model

A crucial component of the project's design is the empowerment of the local community. The project will not simply be an external intervention but a shared asset managed by and for the community. Evidence from successful programs shows that community-led initiatives, with "tried and tested participatory methods," have a higher success rate than those based on a singular technical fix [1, 22, 41]. A local "Water Management Committee" will be established at each site. This committee will receive comprehensive training to oversee daily operations, manage the collection of user fees, and perform minor repairs. This model instills a sense of ownership, ensures local accountability, and creates a sense of shared stewardship.

4.1.3 The Role of Centralized Monitoring (SCADA) in Proactive Maintenance

The centralized SCADA (Supervisory Control and Data Acquisition) system [27, 28] is a critical investment in the project's sustainability. This system is not merely for monitoring but is a strategic tool for proactive management. It will provide real-time data on key performance indicators, including water quality parameters (TDS, pH, etc.) [42], tank levels [43, 44], solar energy production, and pump performance. This real-time visibility allows the foundation's central management team to detect potential issues before they escalate, schedule maintenance proactively, and dispatch mobile technical teams only when necessary. This prevents catastrophic failures and ensures continuous service, thereby building community trust and reinforcing the long-term viability of the project.

4.2 Strategic Recommendations for Future Expansion

The success of Phase I will provide a strong foundation for future expansion. It is recommended that subsequent phases be strategically planned and adapted to new geographical areas.

4.2.1 Phase II: Target Provinces and Project Expansion

Following the completion and successful operation of Phase I, the foundation should consider expanding its efforts to other provinces with high rates of deprivation and water scarcity. Balochistan, with its high rates of rural poverty and dried-up water sources, and Sindh, where a large percentage of the rural population is still deprived of sanitation facilities, are prime candidates for future phases [29, 30].

4.2.2 Diversification of Solutions for Different Geographies

The lessons learned from Phase I's site-specific contaminant analysis will inform future projects. It is recommended that future phases diversify the technical solutions to address a wider range of challenges, such as areas with minimal groundwater or unique types of contamination.

4.3 Conclusion: A Path to Health, Dignity, and Human Rights

The Tameer e Watan Foundation's clean water initiative is more than just a public welfare project; it is a strategic and well-reasoned investment in the future of Pakistan's rural communities. By providing access to clean and healthy drinking water, the project will directly address the root causes of disease and poverty, alleviate the disproportionate burden on women and girls, and empower communities to build a healthier, more prosperous future. This project is a tangible step toward upholding the fundamental human right to water, demonstrating that with a responsible, data-driven, and community-centric approach, even the most daunting challenges can be overcome.

References

[1] **The NGO World: Clean Water, Healthy Lives** - https://www.thengoworld.com/clean-water-healthy-lives/
[2] **National Drinking Water Policy, Government of Pakistan** - https://mocc.gov.pk/PolicyDetail/YTA0ZDNkYjEtZTdlNC00N2M3LTg4YjgtNTIzMzUxYzg0MjEy
[3] **Water supply and sanitation in Pakistan, Wikipedia** - https://en.wikipedia.org/wiki/Water_supply_and_sanitation_in_Pakistan
[4] **Water Scarcity in Pakistan: Analyzing Its Political, Social, And Economic Impacts, ResearchGate** - https://www.researchgate.net/publication/391612207_Water_Scarcity_in_Pakistan_Analyzing_Its_Political_Social_And_Economic_Impacts
[5] **A Comprehensive Review of Water Contamination in Pakistan, MDPI** - https://www.mdpi.com/2071-1050/15/7/6246
[6] **The Association between Water, Sanitation, Hygiene, and Child Underweight in Punjab, Pakistan, ResearchGate** - https://www.researchgate.net/publication/380813770_The_Association_between_Water_Sanitation_Hygiene_and_Child_Underweight_in_Punjab_Pakistan_An_Application_of_Population_Attributable_Fraction
[7] **Water Scarcity and Contamination, a Challenge to National Security in Pakistan, Frontiers in Water** -

https://www.frontiersin.org/journals/water/articles/10.3389/frwa.2024.1267164/full
[8] **Assessment of arsenic, fluoride, bacteria, and other contaminants in drinking water sources for rural communities of Kasur and other districts in Punjab, Pakistan, ResearchGate** - https://www.researchgate.net/publication/309723655_Assessment_of_arsenic_fluoride_bacteria_and_other_contaminants_in_drinking_water_sources_for_rural_communities_of_Kasur_and_other_districts_in_Punjab_Pakistan
[9] **Arsenic and other drinking water quality issues, Muzaffargarh District, Pakistan, ResearchGate** - https://www.researchgate.net/publication/222414499_Arsenic_and_other_drinking_water_quality_issues_Muzaffargarh_District_Pakistan
[10] **Drinking Water Quality in Punjab, Pakistan, PE Congress** - https://pecongress.org.pk/images/upload/books/616.pdf
[11] **Level of fluoride in drinking water of district Kasur, ResearchGate** - https://www.researchgate.net/figure/Level-of-fluoride-in-drinking-water-of-district-Kasur_fig3_309723655
[12] **Hydro-geochemistry of the Indus Basin in Rahim Yar Khan District, Central Pakistan, Journal of the Chemical Society of Pakistan** - https://jcsp.org.pk/ArticleUpload/1241-5566-1-CE.pdf
[13] **Physicochemical Profile of Ground Water in Bahawalpur City, Pakistan: Hazardous Aspects, ResearchGate** - https://www.researchgate.net/publication/311306625_Physicochemical_Profile_of_Ground_Water_in_Bahawalpur_City_Pakistan_Hazardous_Aspects
[14] **The Association between Water, Sanitation, Hygiene, and Child Underweight in Punjab, Pakistan, PMC** - https://pmc.ncbi.nlm.nih.gov/articles/PMC11128241/
[15] **Level of fluoride in drinking water of district Kasur, ResearchGate** - https://www.researchgate.net/figure/Level-of-fluoride-in-drinking-water-of-district-Kasur_fig3_309723655
[16] **Socio economic impact of water crisis on Agrarian community, ResearchGate** - https://www.researchgate.net/publication/287301495_Socio_economic_impact_of_water_crisis_on_Agrarian_community
[17] **The Impact of Water Scarcity on Women in Rural Area in Quetta, ResearchGate** - https://www.researchgate.net/publication/342556161_The_Impact_Of_Water_Scarcity_On_Women_In_Rural_Area_In_Quetta
[18] **Water supply and sanitation in Pakistan, Wikipedia** - https://en.wikipedia.org/wiki/Water_supply_and_sanitation_in_Pakistan
[19] **Clean Drinking Water for All, PMDFC** - https://pmdfc.punjab.gov.pk/clean_drinking_water_for_all
[20] **Pakistan to Invest in Water and Sanitation Services to Boost Health and Climate Resilience in Punjab Province, World Bank** - https://www.worldbank.org/en/news/press-release/2021/06/18/pakistan-to-invest-in-water-and-sanitation-services-to-boost-health-and-

climate-resilience-in-punjab-province
[21] **Homepage, WaterAid Pakistan** - https://www.wateraid.org/pk/
[22] **Information flows faster than water: Lessons from the Pakistan floods, Fair Planet** - https://www.fairplanet.org/dossier/water-2/information-flows-faster-than-water-lessons-from-the-pakistan-floods/
[23] **Boring and Drilling, UltraPure Pakistan** - https://ultrapurepakistan.com/boring-and-drilling/
[24] **RO Water Filter Plant Price in Pakistan, OGO** - https://www.ogo.com.pk/blogs/ro-water-filter-plant-price-in-pakistan
[25] **Royal Solar Trusted Solutions in Pakistan, Royal Solar** - https://royalsolar.pk/
[26] **Solar Pumps Solution in Pakistan, Feroze Power** - https://www.ferozepower.com/solar-pumps/
[27] **SCADA Solutions, The Automators** - https://www.automators.com.pk/solutions/solutions-pages/scada-solutions/
[28] **Pakistan | Malik Automation | PLC | RTU | SCADA Control System, Malik Automation** - https://www.malikautomation.com/
[29] **Deprivation Profile of Households in Rural Pakistan, ResearchGate** - https://bereview.pk/journal/index.php/ber/article/download/233/209/390
[30] **WB pledges record $40 billion for Pakistan reforms, The Tribune** - https://tribune.com.pk/story/2568666/wb-pledges-record-40-billion-for-pakistan-reforms
[31] **Solar System Solutions, ROSolution PK** - https://rosolutionpk.com/solar-system-solutions/
[32] **What Impacts Whole House RO Costs, Crystal Quest** - https://crystalquest.com/blogs/reverse-osmosis/what-impacts-whole-house-ro-costs
[33] **RO Plant Price in Pakistan, Waterzone** - https://waterzone.com.pk/ro-plant-price-in-pakistan/
[34] **Aqua Commercial RO Water Plant in Pakistan, Aqua Filter** - https://aquafilter.pk/product/commercial-ro-plant/
[35] **The True Cost of Drinking Water: Understanding the Expenses of Reverse Osmosis Plants, Medium** - https://medium.com/@desalter/the-true-cost-of-drinking-water-understanding-the-expenses-of-reverse-osmosis-plants-4254b4f3f166
[36] **What Impacts Whole House RO Costs, Crystal Quest** - https://crystalquest.com/blogs/reverse-osmosis/what-impacts-whole-house-ro-costs
[37] **Wastewater Treatment Plant Operator Salary in Pakistan, ERI Economic Research Institute** - https://www.erieri.com/salary/job/wastewater-treatment-plant-operator/pakistan
[38] **RO membrane 75gpd, Daraz.pk** - https://www.daraz.pk/tag/ro-membrane-75gpd/
[39] **Price of Water Filtration Plant in Pakistan 2025, Aqua Solutions** - https://aquasolutionspk.com/water-filtration-plant/
[40] **Analysis of dam-breach induced flood and inundation in the downstream area, MDPI** - https://www.mdpi.com/3042-5743/32/1/22
[41] **IWMI Introduces Sustainable Water Management to Farming Community in**

Pakistan, International Water Management Institute - https://www.iwmi.org/blogs/iwmi-introduces-sustainable-water-management-to-farming-community-in-pakistan/
[42] **Water Quality Monitoring, Buraq Integrated Solutions** - https://buraq.com/water-quality/
[43] **Water Tank Automation System, eSync n Secure** - https://esyncnsecure.com/water-tank-monitoring-system/
[44] **Digital Water Level Meter with 8 Aluminum Contact Sensors, Daraz.pk** - https://www.daraz.pk/products/digital-water-level-meter-with-8-aluminum-contact-sensors-accurate-rust-free-water-monitoring-system-i2803573.html